

## Project Summary

- *This proposal submits the Homestake mine in Lead, South Dakota as a candidate site for the Deep Underground Science and Engineering Laboratory (DUSEL) in response to solicitation # NSF-05-506. The Homestake plan will provide a safe, accessible, existing mine with experiments down to a depth of 8000 ft. below the surface, reached by existing shafts and drifts. Actions by the State of South Dakota will result in an early implementation of the first set of experiments at 4850 (foot deep) level as early as 2006.*
- **Intellectual merit:** The proposed DUSEL at Homestake will address the underground needs of all of the major scientific fields included in the NSF solicitation process: particle and nuclear physics, geology, hydrology, geo-engineering, biology, and biochemistry. Homestake is the deepest mine in North America with rooms at 8000 ft., well-suited for experiments that require extremely low cosmogenic backgrounds: in particular, the search for neutrino-less double beta decay and relic dark matter. The Yates formation has well characterized strong rock that can support deep large cavities for very large multipurpose detectors for proton decay and neutrinos from many different natural sources. These large detectors can be used for long baseline neutrino experiments using beams from US accelerator laboratories located at appropriate distances from Homestake. The large number of tunnels, shafts, boreholes, dedicated access and well known patterns of water flow will allow studies of the dynamics of the earth's crust and critical issues of carbon sequestration and rock mechanics over long time scales and many length scales. The dedicated access and the diverse geology at Homestake are well-suited for studies of microbiology and life at extreme depth.
- *Homestake is a two-level facility: the upper levels from the surface to 4850 ft are serviced by one set of utilities and the 4850 to 8000 levels by a second set. Following closure in 2003, pumps were turned off and water has started accumulating in the mine. The rate of water rise is well known; its current level is at 6700 ft. Without intervention the water will rise to the 4850 level in 2008. Since about 2/3 of the water inflow is above 5300 level, it can be pumped out by existing unaffected equipment in the upper levels. The South Dakota Science and Technology Authority (SDSTA) has created a comprehensive conversion plan to dewater the mine (a common practice in the mining industry) and make it available for science down to 8000 ft. The scope, cost and schedule of the conversion plan was developed by Dynatec Corp. of Toronto, Canada, a well respected mine engineering firm. The plan was well-received by the State of South Dakota, Barrick Corp., the current owner of Homestake, and an expert review panel. This plan will form the initial basis of the DUSEL laboratory at Homestake.*
- **An important component of the conversion plan is assurance of safe access and operations in Homestake. We believe that the culture of safety that already exists at Homestake (and the Safety Plan outlined in the Conversion Plan and its Technical Review) is very important.**
- *There is an "Agreement in Principle" between South Dakota and the Barrick Gold Corp. stating that Barrick will donate Homestake to the State for use as a DUSEL. As part of this agreement issues of liability and insurance have been resolved. The SDSTA and Barrick have made a detailed schedule to transfer the mine and create a fiscal and management plan. This process, and the necessary water discharge permitting, should be finished in mid 2005.*
- **Following mine transfer, the SDSTA will embark on an early implementation of the conversion plan. The early implementation will make the levels above 4850 ft. accessible for science and prevent the water from reaching (& holding at) 5300 level. Existing rooms and other infrastructure between the two upper shafts (Ross and Yates) will become usable for a range of experiments. Anticipating this development, letters of interest will be solicited from the scientific community.**
- **Broader implications:** *The SDSTA has developed a significant outreach and education plan that will also take effect as early as possible. The plan includes the local institutions, schools, colleges, and universities, and minorities. Because Homestake, perhaps uniquely, will be able to bring together into **one campus the full range of S-I sciences**, we expect interdisciplinary projects on a scale not possible previously anywhere. Several of the technologies being developed for enabling this science on this scale will be new and are likely to have applications in areas beyond that of their origin.*
- **The plan for Homestake provides a safe, economically feasible home for DUSEL carrying little technical or schedule risk, and has great long term potential for underground science. We expect to provide a full development of this plan as part of the NSF DUSEL site selection process.**